NATIONAL PARK SERVICE
CHANNEL ISLANDS NATIONAL PARK

TECHNICAL REPORT 01-06

TERRESTRIAL VEGETATION MONITORING
CHANNEL ISLANDS NATIONAL PARK
1996–2000 REPORT

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SEPTEMBER 2001

ABSTRACT

Channel Islands National Park began a long-term plant community monitoring program on Anacapa, Santa Barbara, and San Miguel Islands in 1984. Monitoring on Santa Rosa Island began in 1990 and on East Santa Cruz Island in 1998. Species present at each of 100 points along 163, 30-m permanent transects, are recorded annually. The number of transects on each island is determined by the island's size and the diversity of its vegetation. Anacapa Island has 16 transects, Santa Barbara Island has 24, San Miguel Island has 16, Santa Rosa Island has 86, and East Santa Cruz Island currently has 21. This report presents the data, summarized by transect, that were collected on all five islands from 1984 - 2000. Although data from 1984 to 1995 were previously presented in Technical Report 98-08, inclusion of those data in this report presents a more complete picture for comparative purposes. For analysis of vegetation trends, the transect data should be aggregated by community types. Relative frequency of natives vs. exotics, perennials vs. annuals, and comparison of graminoids, herbs, sub-shrubs, shrubs, and trees can be derived from the data. This report supplements Technical Report 98-08, Terrestrial Vegetation Monitoring, Channel Islands National Park, 1984-1995 Report. No analysis is presented in this annual report, however an analysis of the vegetation data is underway and will be presented in an upcoming Trend Report. In addition, a review of the overall vegetation monitoring program was conducted in December 2000. The recommendations from that review are summarized in this report. A more complete overview of that review will also be forthcoming.

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INTRODUCTION

Channel Islands National Park was created in 1980, from what had been Channel Islands National Monument. The Park's enabling legislation (PL 96-199) required that the Park develop a study of the natural resources including 1) an inventory of all species in the Park including population dynamics, 2) an assessment of present conditions and probable future trends of populations, and 3) recommendations as to what actions should be considered for adoption to better protect the natural resources of the Park.

The Park used this legislation as an opportunity to develop a model system for monitoring natural resources in national parks (Davis and Halvorson, 1988). It also recognized that restoration and protection of Park resources required an ecological monitoring program to assess the effectiveness of these efforts and to determine limits of natural variation, detect abnormal conditions, and prescribe potential remedial treatments. One of the ecolological components selected for monitoring was terrestrial vegetation.

All of the islands have been altered by past land use. The vegetation is in various stages of recovery from managed and unmanaged grazing, farming, military use, and introduction of exotic species. Monitoring offers an opportunity to measure natural recovery, the effectiveness of management actions to restore island vegetation, and the impacts of various management actions.

The terrestrial vegetation monitoring program was designed to monitor the changes that are taking place in the usual vegetation units or representative plant communities (Halvorson et al. 1988). It was not designed to monitor communities that are unusual because of rarity or location. It was also not intended to monitor individual plant species.

Annual reports provide ongoing documentation of the program's objectives, methods, and results. This report presents the data collected from 1996 through 2000 as well as sampling dates and personnel, any deviations in methods and locations, questions or difficulties that should be resolved prior to more sampling, and suggested modifications to the sampling protocol. Data are to be analyzed periodically to determine vegetation and trend; the results of analyses are then to be presented in trend reports.

Expanded riparian and woody species data collection was incorporated into the vegetation monitoring program for the east end of SCI and SRI in 1998. This will be expanded to all the islands in 2001. These data are not reported here, however. Beginning with the 2001 data, annual reports will present each year's data individually.

VEGETATION MONITORING METHODS

Study Area

Channel Islands National Park consists of 5 of the 8 California Channel Islands (Figure 1). Four of the islands—Anacapa, Santa Barbara, Santa Rosa, and San Miguel—are wholly administered by Channel Islands National Park while only a portion of Santa Cruz Island is administered by the National Park Service. The majority of Santa Cruz Island (approximately 80 percent) is owned and administered by The Nature Conservancy (TNC). Santa Barbara Island is the only southern Channel Island within the Park. These islands lie 20–73 kilometers (km) off the coast of Southern California. They range in size from the smallest, Santa Barbara Isand, at 260 hectares (ha) to the largest island, Santa Cruz, at 25,000 ha. The total area of the Park is 100,000 ha, divided nearly equally between submerged lands and the islands. Anacapa Island is the closest to the mainland and lies 22 (km) from the nearest mainland city, Ventura, California, while the western most island, San Miguel, is 100 km from Ventura.

The terrestrial vegetation of the Channel Islands, like that of the mainland, is strongly influenced by the Mediterranean climate. This climate is characterized by cool, wet winters and dry warm summers with virtually no rain from May to October. Unlike the mainland (except for the immediate coast) there is a strong maritime influence on the islands with cooler temperatures during the summer and significant moisture from the frequent marine layer.

History

Channel Islands National Park began implementation of its Terrestrial Vegetation Monitoring Program in 1984 with installation of permanent transects on Anacapa, Santa Barbara, and San Miguel Islands. Prior to 1984, permanent transects had been installed on those islands by the Santa Barbara Botanic Garden and others for a variety of monitoring efforts. Some of those transects were incorporated into the current monitoring program. The Santa Barbara Botanic Garden transects used a line-intercept protocol that is compatible with the point-intercept technique chosen by the Park. However, the data collected before 1984 have not been incorporated into this database and are not presented in this report. In 1990, after vegetation classification and mapping were completed, 85 permanent transects were installed on Santa Rosa Island. In 1994, an additional transect was installed on SRI to capture vegetation changes within a newly erected cattle exclosure. With the removal of cattle from SRI in 1998, this transect may no longer be needed. The east end of Santa Cruz Island was acquired by the Park Service in 1997. After the completion of vegetation classification and vegetation mapping, permanent transects were installed on the island beginning in 1998. Currently there are 21 transects installed on the east end of Santa Cruz Island. In July of 2000, an additional 10 percent of the island, called the Isthmus, was donated by The Nature Conservancy to Channel Islands National Park. Monitoring of the terrestrial vegetation on that portion of the island has not yet begun. The Nature Conservancy, which owns approximately 80 percent of Santa Cruz Island, has in the past conducted its own vegetation monitoring. Protocols for their monitoring program are similar to those used by Channel Islands National Park. However, their program is not associated with the Parks terrestrial vegetation monitoring program and those data are not presented in this report.

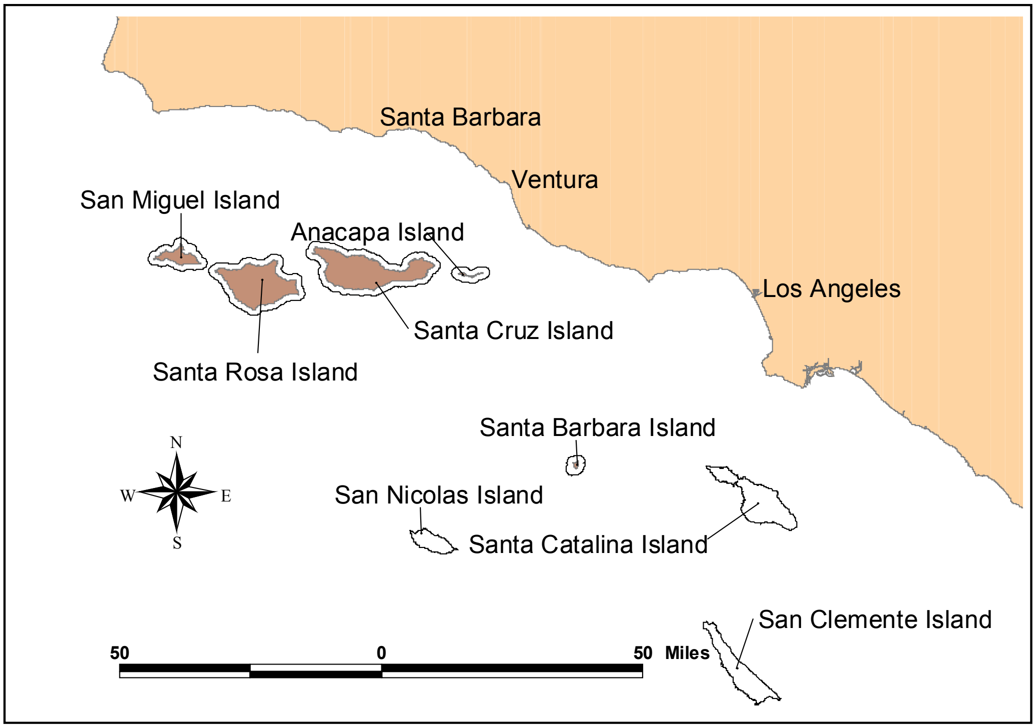
While the number of transects read annually vary due to weather, missing markers, and nesting seabirds, most transects are read in most years. The exceptions to this have been 1989, 1991, and 1992 when no data were collected due to staffing problems.

The communities monitored and the transects that represent them on each island are listed in Table 1. Transect locations are shown in Figure 2 (Santa Barbara Island), Figure 3 (Anacapa Island), Figure 4 (San Miguel Island), Figure 5 (Santa Rosa Island), and Figure 6 (Santa Cruz Island). It is expected that an analysis of the transect data, now underway, may lead to modifications in community definitions, or in the frequency of monitoring, or indicate addition or deletion of transects in some communities.

Table 1 Vegetation communities monitored on each island and representative transects.

Community	Transects
Santa Barbara Island	
Boxthorn Scrub	08N, 16
Cactus Scrub	09N, 10N, 14
Coastal Sage Scrub	20
Coreopsis Scrub	09S, 10S, 11, 12, 15, 17, 21
Grassland	01, 06, 18, 19
Seablite Scrub	02, 03, 04, 05
Sea Cliff Scrub	07, 08S, 13
Anacapa Island	
Coreopsis Scrub	01W, 02W, 03E
Coastal Sage Scrub	02M, 03W, 04W
Grassland	01M, 02E, 03M, 04E, 04M, 05M, 05W, 06W
Perennial Iceplant	01E, 05E
San Miguel Island	
Caliche Scrub	01, 02
Island Chaparral	06, 07, 08, 12
Coreopsis Scrub	13, 15, 16
Coastal Sage Scrub	05, 11, 18
Coastal Dune Scrub	14
Grassland	03, 04, 10
Sea Cliff Scrub	09
Santa Rosa Island	
Baccharis Scrub	02, 05, 14, 15, 26, 27, 28, 29, 30
Caliche Scrub	45, 46
Coastal Bluff Scrub	49, 50, 51
Island Chaparral	11, 13, 20, 21, 34, 35
Coastal Sage Scrub	40, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61
Grassland	01, 04, 08 ,09, 10, 12, 19, 22, 23, 24, 25, 31, 32, 33, 36, 37, 38, 39, 42, 43, 44, 47,48
Lupine Scrub	16, 17, 18
Coastal Marsh	06, 07
Mixed Woodland	63, 68, 69, 70, 71, 76, 79
Oak Woodland	74, 75, 77, 78
Riparian (herbaceous and woodland)	80, 81, 82, 83, 84, 85, 86
Santa Cruz Island Pine	72, 73
Coastal Strand	03, 41
Torrey Pine	62, 64, 65, 66, 67
Santa Cruz Island (East end)	
Coastal Bluff Scrub	13, 14
Disturbed shrub savannah	15, 19
Grassland	12, 16, 17, 18, 20, 22
Island Chaparral	01, 03, 04, 06, 07
Lynothamnus Grove	05, 08, 10
Mixed woodland	02
Riparian	11, 21
Note: Transect 9 is missing and has not yet been relocated.	

Figure 1 Channel Islands National Park, California. The Park includes San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands. The Park boundary extends for 1 mile around each of the five islands within the Park.



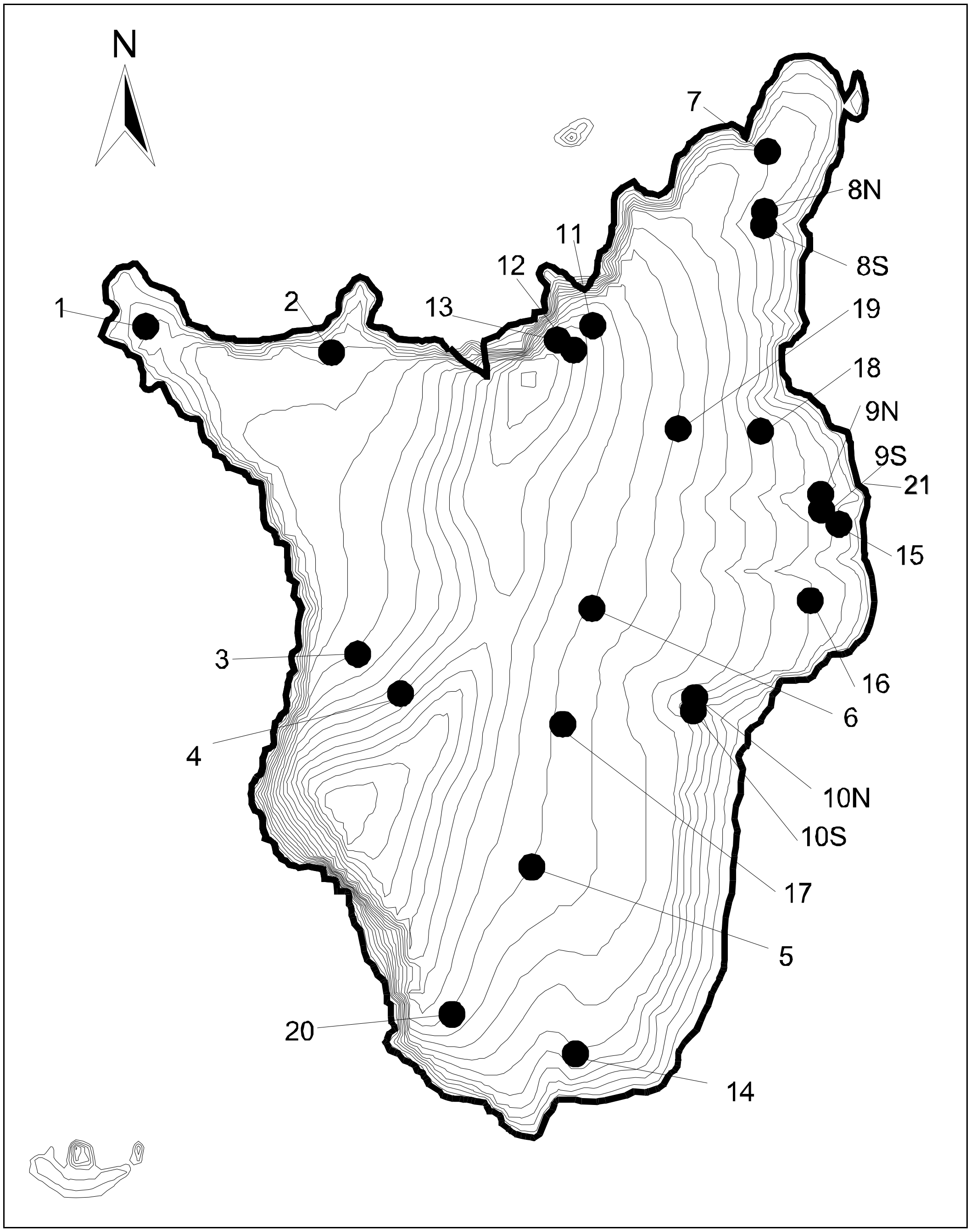


Figure 2 Vegetation transect locations on Santa Barbara Island

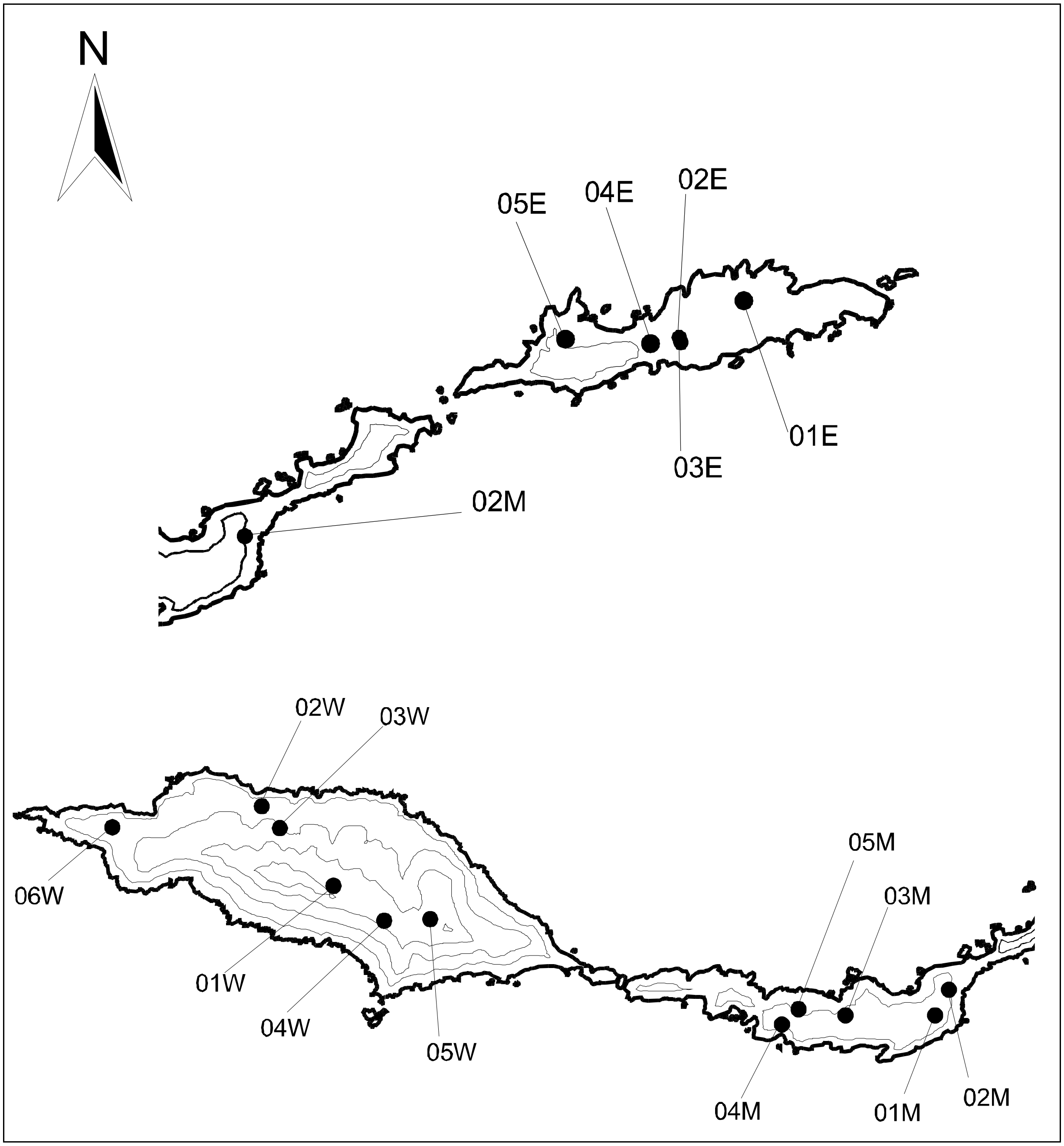


Figure 3 Vegetation transect locations on East Anacapa Island (top) and West and Middle Anacapa Island (bottom)

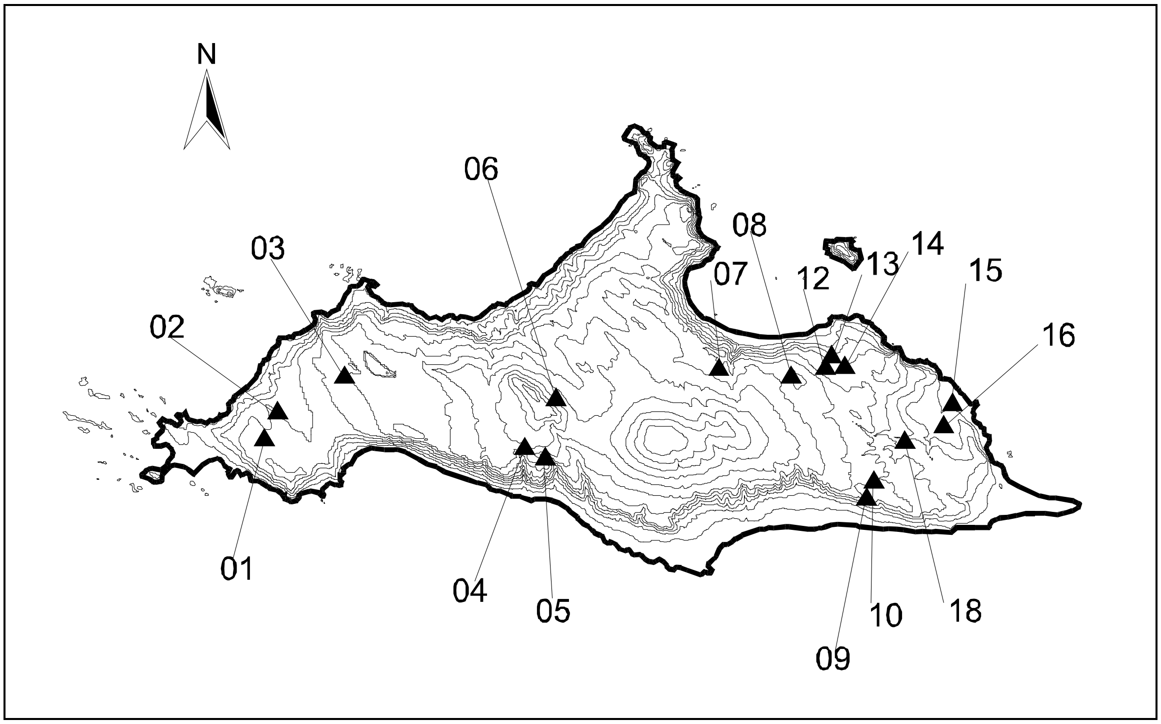


Figure 4 Vegetation transect locations on San Miguel Island

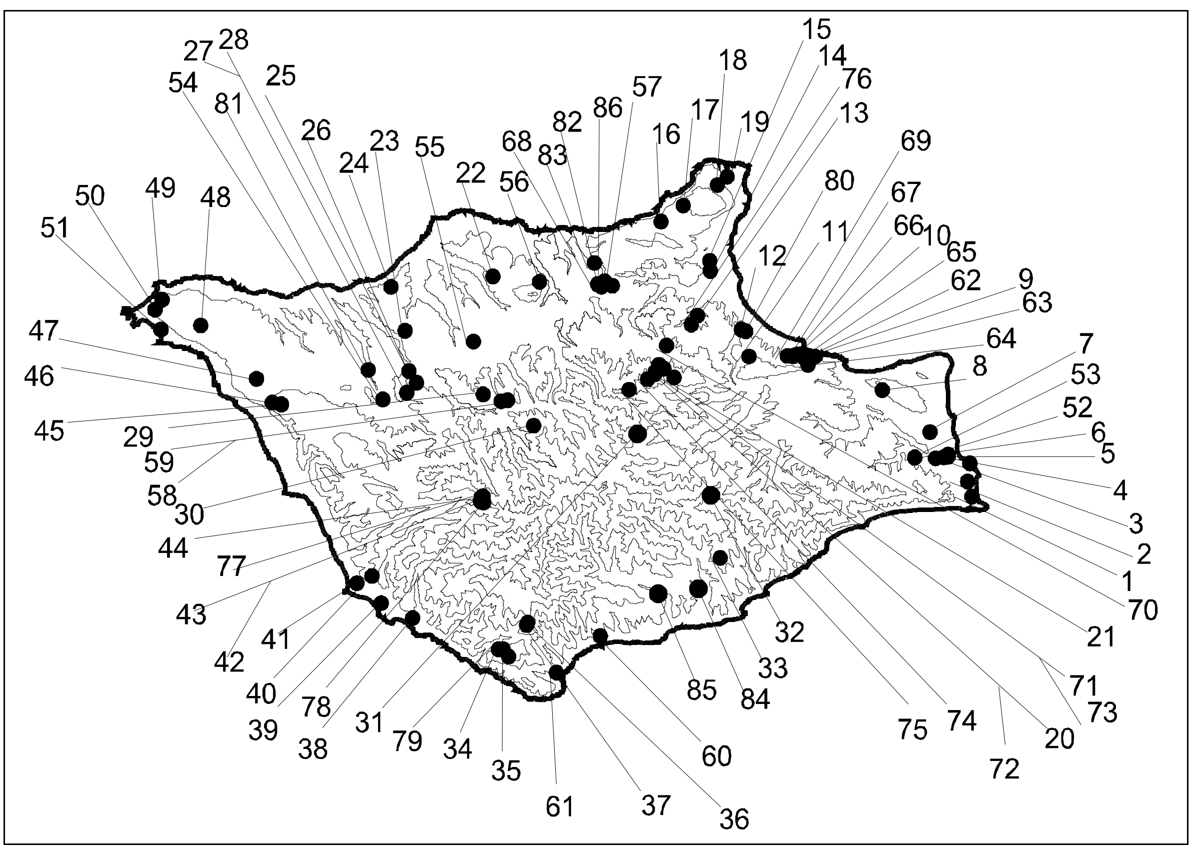


Figure 5 Vegetation transect locations on Santa Rosa Island

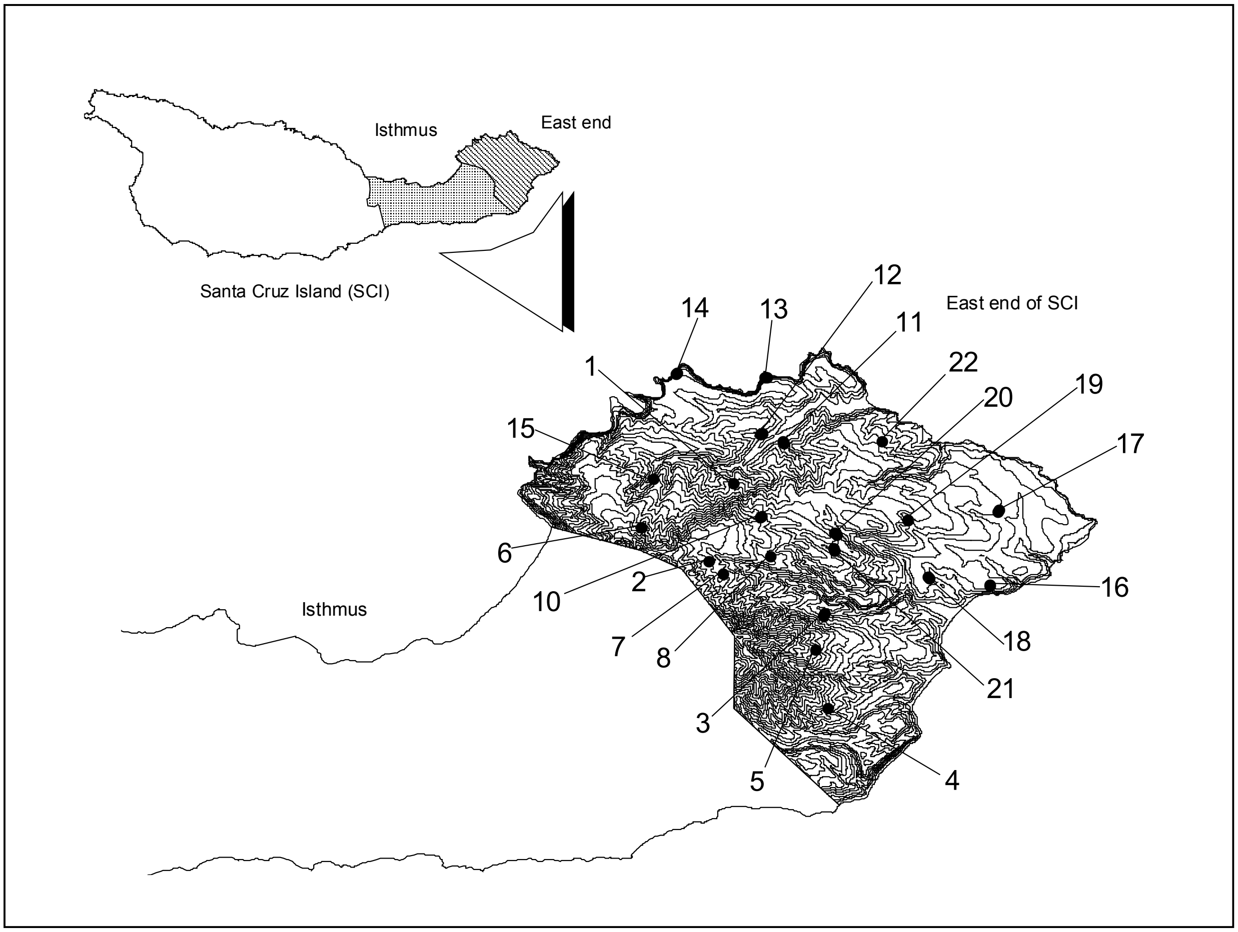


Figure 6. Vegetation transects on the east end of Santa Cruz Island – to date. Shaded areas are managed by Channel Islands National Park. The east end of SCI was acquired by NPS in 1997. The isthmus portion of the island was donated to NPS by The Nature Conservancy in 2000.

Community Descriptions

Each park island supports a unique assemblage of vegetation communities. The differences are often subtle, and are due to different climates, microhabitats, geology, soils, plant colonization history, and land use history. Long-term monitoring is intended, in part, to reveal whether differences that are present now are natural/inherent or are the result of past land use practices. It is believed that on some of the islands grasslands composed of exotic annual grass species now occupy areas formerly supporting a mosaic of perennial grasslands and shrublands.

A brief description of the island communities is included here. For more detailed information, see Philbrick and Haller 1977, Powers 1979, Junak et al. 1980, Lenihan 1983, Halvorson et al. 1988, Clark et al. 1990, and Junak et al. 1995. Table 1 lists the monitored communities.

Santa Barbara Island

This small island is dominated by exotic **grassland.** This plant community, which occupies more than half of the island, is composed of annual *Avena*, *Bromus*, and *Hordeum* species. The low-growing exotic sub-shrub, Australian saltbush (*Atriplex semibaccata)*, is an important component of the grassland in some areas. A few individuals of coyote brush (*Baccharis pilularis)* occur in the grasslands and may represent a forthcoming successional stage in those areas. A handful of shrub communities also occur on Santa Barbara Island. These are boxthorn scrub, cactus scrub, Coreopsis scrub, sea cliff scrub, coastal sage scrub, and seablite scrub. Areas dominated by crystalline iceplant (*Mesembryanthemum crystallinum*) also occur on the island. There are no tree species on Santa Barbara Island.

Anacapa Island

Anacapa Island is comprised of three islets. East and Middle Anacapa are flat plateaus while West Anacapa is a mountainous ridge. This, in addition to different land use histories, has led to some differences in vegetation. All three islets have **sea cliff scrub** on their northern slopes and **coastal sage scrub** on their southern slopes. These communities are well developed on West Anacapa Island, moderately developed on Middle Anacapa Island, and marginal on East Anacapa Island. Large areas on East Anacapa Island are covered by perennial **iceplant** (*Carporotus chilensis, C. edulis, Malphora crocea*) introduced by the U.S. Coast Guard for erosion control. These alien species are much less common on the other two islets. There is a low-level but continuing effort to remove perennial iceplant from East Anacapa Island. Mixed annual and perennial **grassland** are well distributed on East Anacapa Island and Middle Anacapa Island but patchier on West Anacapa Island. **Coreopsis scrub** occurs in small, scattered stands on East Anacapa Island and in more extensive stands on Middle Anacapa Island and West Anacapa Island.

San Miguel Island

This island experienced severe over-grazing during the late 1800's and in the early part of the 20th century. Accounts of the island in the early part of the 20th century described the island as "….nothing but a vast pile of continually drifting sand" (Wright and Snyder, 1913). Since the removal of all introduced herbivores in 1977, the native vegetation has recovered dramatically. A striking feature of San Miguel Island is the pronounced northwest-southeast orientation of the topography. This is the result of the influence of the strong, nearly constant northwesterly winds on the island's sandy soils. The many parallel ridges are stabilized sand dunes, which are interspersed in some areas with unstabilized blowouts or erosion pavement. **Beach and coastal dunes** support little vegetation beyond exotic sea rocket (*Cakile maritima*) and native sand verbena (*Abronia maritima*). Increasing distance from salt spray allows more diverse vegetation, including beachbur (*Ambrosia chamissonis*) and beach primrose (*Camissonia cheiranthifolia* s. *cheiranthifolia*), to develop on coastal dunes. Inland dunes that are becoming moderately stabilized frequently support lush **lupine scrub**. **Grassland** and **Isocoma scrub** are the dominant plant communities occurring on all parts of the island. **Caliche scrub,** a primarily herbaceous community, is extensive on the west end of the island and spotty elsewhere. **Coastal sage scrub** is most extensive on the island's steep southern escarpment frequently intermixed with **sea cliff scrub**. It also occurs on some south facing canyon walls occasionally forming impenetrable thickets. **Island chaparral** is extremely depauperate and significantly different in species composition from the other islands and the mainland. The most consistent shrub member of the community is coyotebrush, however, goldenbush (*Isocoma meziesii*) and bush lupine (*Lupinus albifrons*, *L. arboreus*) also occur. **Coreopsis scrub** occurs in a few sites on the northern and eastern bluffs. The Coreopsis canopy is not as high as on the other islands, but the stands tend to be quite dense.

Santa Rosa Island

The vegetation of Santa Rosa Island is quite diverse because of its relatively large size and elevational range.

Grassland dominated by exotic annual grasses is the most prevalent community. Native perennial grasses retain dominance in some areas such as Carrington Point where saltgrass (*Distichlis spicata*) covers many acres. Recovering expanses of native bunch grasses, such as purple needlegrass (*Nassella pulchra*), can also be found. **Caliche scrub** occurs on the west end of the island just as on San Miguel Island. Whereas San Miguel Island locoweed (*Astragalus miguelensis*) was the dominant shrub in caliche on San Miguel Island, goldenbush is more frequent on Santa Rosa Island. **Coastal bluff scrub** has vegetation similar to caliche scrub, notably goldenbush and San Miguel Island locoweed. It occurs primarily on the northern and western coastal bluffs and comprises habitat for soft-leaved paintbrush (*Castilleja mollis*), a federally Endangered species. **Lupine scrub** is an unusually dynamic plant community. The two species of bush lupine exhibit distinct boom and bust cycles, apparently in response to rapid growth, a short life span, and insect herbivory (Davidson and Barbour 1977, Maron 1998). A large portion of Carrington Point seems to oscillate between dense lupine cover and grassland and this has been captured in the the data monitoring. On Santa Rosa Island, coyotebrush dominates enough of the landscape to warrant a distinct community, **baccharis scrub**. Sagebrush and goldenbush are minor components of this community. It has been hypothesised that baccharis scrub is transitional to other shrub communities. It is these types of questions that vegetation monitoring is intended to test. **Coastal sage scrub,** along with grassland and baccharis scrub, is one of the more common plant communities on the island. As on the other islands, it occurs on steep slopes. Unlike the other islands, it is not confined to southern exposures. **Coastal strand** occurs on unconsolidated dunes near beaches and coastal rocks. It is very similar to the coastal dune community on San Miguel. Another coastal community unique to the east end of Santa Rosa Island is **coastal marsh**. Low-growing, salt-tolerant species such as salt grass (*Distichlis spicata*), pickleweed (*Salicornia viginica*), *Frankenia salina*, and *Jaumea carnosa* dominate these small seasonally inundated marshes. Federally listed as threatened western snowy plovers (*Charadrius alexandrinus nirvosus*) nest in marsh vegetation at the upper beach edges and mallards (*Anas platyrhynchos*) nest along the brackish estuary.

Freshwater-dependent plant species occur in the riparian herbaceous and riparian woodland communities. **Riparian herbaceous** vegetation is by far the more common community of the two. It occurs in association with all perennial streams and many of the ephemeral streams. This community tends to be more depauperate than that found on the mainland. Exotic and native grasses and rushes are the most common plants, including upland as well as riparian-dependent species. Vegetated sections are frequently interspersed with sandbars or bare soil. Cattails (*Typha domingensis*) occur in some pools but appear to be expanding in the absence of cattle grazing. Aside from a few scattered willows, **riparian woodland** occurs only in Lobo Canyon on the north side of the island. Arroyo willow (*Salix lasiolepis*), black cottonwood (*Populus balsamifera* s. *trichocarpa*), and elderberry (*Sambucus mexicana*) occur in discrete clumps mostly in the lower stream reaches. In general, the riparian communties have been heavily impacted by grazing.

Trees are also found in island chaparral, mixed woodland, Torrey pine woodland, Santa Cruz Island pine woodland, and oak woodland communities. **Island chaparral** is strongly associated with the Monterey shale formation that underlies Black Mountain in the east-central part of the island. Small patches are also found near East Point and South Point. Scrub oak (*Quercus pacifica*), chamise (*Adenostoma fasciclatum*), toyon (*Heteromeles arbutifolia*), coyotebrush, and monkey flower (*Mimulus flemingii*) are frequently found together; tree poppy (*Dendromecon* *rigida*) and manzanita (*Arctostaphylos confertiflora, A. tomentosa*) are occasionally found. The scrub oak, chamise, and manzanita show upright and prostrate forms depending on the amount of wind exposure. **Mixed woodland** occurs primarily in the larger canyons in the northeast portion of the island. Tree species that occur there are coast live oak (*Quercus agrifolia*), island oak (*Q. tomentella*), island cherry (*Prunus ilicifolia* ssp. *lyonii*), and ironwood (*Lynothamnus floribundus* ssp. *asplenifolius*). Arborescent shrubs that occur in mixed woodland are toyon and scrub oak. Generally, one of these species strongly dominates a stand while the others are absent or insignificant. **Torrey pine woodland** is represented by only two stands on the island, both on the east end. There is variation within the stands; some areas are closed canopy monotypic *Pinus torreyana* sites while other areas are open and grassy with several tree and shrub species present in the understory. **Santa Cruz Island pine** is most developed on the north side of Black Mountain. There are scattered individuals on other parts of the island. *Pinus remorata* is similar to *P. torreyana* in its variability of density. However, while shrub and herbaceous cover increase in the less dense sites, other tree species do not occur. **Oak woodland** is defined by the presence of island oak that is endemic to the northern Channel Islands. This community occurs mainly on Soledad Peak and Black Mountain frequently in monotypic stands with no understory vegetation. Some oak groves also contain toyon. Recent discoveries of isolated island oaks have expanded the habitat boundary on the island for this species.

East End of Santa Cruz Island

Santa Cruz Island is actually the largest island within Channel Islands National Park. Consequently, in its entirety, Santa Cruz Island is the most diverse of all the Channel Islands. The main portion of the island is characterized by steep, rugged terrain with the main northern and southern ridges separated by a large central valley. However, only the eastern part of the island is owned and administered by the National Park Service. Consequently only the vegetation communities found on the east end of the island will be discussed in this report.

The current condition and extent of plant communities on the east end of Santa Cruz Island reflects the grazing history of the island. From the 1850's to 1999, this part of the island was severely disturbed by the presence of feral sheep, feral pigs, and other alien herbivores on the island. Although feral pigs are still present, nearly all of the sheep have been removed and the recovery of the native vegetation has begun.

The east end of Santa Cruz Island is edged for the most part by steep coastal bluffs which flatten upland into broad plateaus. As one traverses inland to the west, the topography becomes extremely steep before dropping down to the isthmus part of the island which connects the east end to the rest of Santa Cruz Island. **Coastal bluff scrub** occurs on the steep coastal cliffs and slopes. The dominant plant species can vary with slope exposure, geologic substrate, and location. The common plant species found in this community include *Achillea millefolium, Calystegia macrostegia* ssp. *macrostegia, Coreopsis gigantea, Dudleya greenei*, and *Eriogonum grande* var. *grande*. The broad flats or plateaus at the east end are dominated by exotic, **annual grasslands**. The annual grasslands run up into the steep slopes to the west before giving way to remnant patches of island chaparral and oak woodland. Native bunchgrasses, primarily *Nassella pulchra*, do occur and sometimes dominate in scattered patches throughout the annual grasslands. Also scattered throughout the annual grasslands are solitary shrubs such as *Heteromeles arbutifolia, Quercus pacifica*, and *Rhus integrifolia*. These isolated shrubs probably represent the former extent of the native shrub communities at the east end of the island.

It is believed in the absence of grazing, native shrub communities, such as coastal sage scrub and island chaparral, will recolonize much of the areas now dominated by annual grasses. Tucked into the steeper north-facing slopes and drainages are stands of island woodland. **Island woodland** is usually dominated by one or two species of the several tree or tree-like species found on the island. These species include *H. arbutifolia*, *Lynothamnus floribundus* ssp. *aspleniifolius*, *Prunus illicifolia* ssp. *lyonii*, *Quercus chrysolepis*, *Q. macdonaldii*, and *Q. tomentella*. Diversity and cover of the understory species within this community tends to be low. Remnant patches of **island chaparral** are also found on the eastern end of Santa Cruz Island. The island form of chaparral tends to be more arborescent than mainland chaparral communities. Whether this arborescent form is due to ecological conditions or is an artifact of intensive grazing is not yet known. Island scrub oak (*Q. pacifica*) seems to be the dominant species within the island chaparral community but toyon, manzanita (*A. viridissima*), and summer holly (*Comarostaphylos diversifolia* ssp. *planifolia*) also occur. The **riparian communities** on the east end of Santa Cruz Island are extremely depauperate due to the island's intensive grazing history. The vegetation found within stream bottoms is dominated by weedy, exotic annuals but sticky baccharis (*Baccharis douglasii*) and willow (*Salix sp.*) do occur rarely.

In July 2000, an additional 10 percent of Santa Cruz Island called the Isthmus was donated by TNC to Channel Islands National Park. This approximately doubled the acres owned by the Park Service on SCI. The Park, however, has not yet incorporated the new area in its formal monitoring program and it will not be included in this report.

Techniques

Plant communities are sampled according to protocols defined in the *Terrestrial Vegetation Monitoring Handbook* (Halvorson et al. 1988). Permanent 30-m point intercept transects were established in the major plant communities of each island (Halvorson et al. 1988; Clark et al. 1990). In the spring of each year, species presence is recorded at each of 100 points, spaced 30 cm apart on each transect. The height of the tallest plant at each point is recorded. Each transect and its surrounding vegetation are photographed. Some transects on ANI, SBI, and SMI were established from previous monitoring efforts and were incorporated into the Park's formal monitoring program. Sometimes adjustments were made to better integrate those transects into the program. For example, transects on Santa Barbara Island and Anacapa Island that were installed by Santa Barbara Botanic Garden are 130 points long (40 m). Some of these run down one slope of a canyon and up the other. These have been split into 2 short transects (approximately 65 points each) so that the effects of different aspects are not mixed.

The monitoring season typically begins in mid-to-late February and continues through mid-to-late July. Dates for monitoring on each island are shown in Appendix A.

All transect data were entered on data sheets in the field or voice recorded on a tape recorder and transcribed onto data sheets at the field station. After proofreading and species verification, all data were entered into the Park's LandVeg database and proofread again. The data sheets and plant specimens are archived at Channel Islands National Park. Since 1995, the vegetation data have been stored and managed in Microsoft® Access. A complete description of the new data management protocols will be included in the next edition of the *Terrestrial Vegetation Monitoring Handbook*.

All researchers used 50-m fiberglass tapes to delineate the transects. *Point poles* marked in 5-cm increments were held vertically at points every 30 cm along the transect to determine species and height. The instrument used for the point pole has been changed at least twice since monitoring began in 1984. The original instrument was a *range pole*; this was used in 1984 and 1985. From 1986 through 1990, botanists used a 1-inch diameter *PVC pipe* that was slightly smaller in diameter than the range pole. In 1993, the instrument was changed again to the *ski poles* that are currently in use. The ski poles are slightly smaller in diameter than the PVC pipe.

Transects have been read from “A to B”, from “B to A”, and, when two botanists work on the same transect, from both ends toward the middle. The “A” point is the zero point on the transect and the tape delineating it. The “B” point is the opposite end of the transect. These points are marked with aluminum, rebar, or Carsonite stakes. In some cases, data that were collected in a “B to A” direction were also entered on the data sheet in that order. Wherever these *backward* data were recognized, it has been noted on the data sheet and reentered in the correct order in the database.

Substrate material (for example, soil and litter) has been recorded differently over time. In 1984 and 1989, substrate was usually recorded only for those points where no vegetation was intercepted. In 1985 through 1988, 1993, and 1994, substrate was sometimes recorded at all points and sometimes only at those points without vegetation. By 1995, recording substrate at all points was standard on all islands except for some transects on SRI in 1999. That year, due to a change in personnel, substrate material was not recorded on every point for approximately half of the transects. The recording of substrate information at all the points is intended to more accurately reveal changes in soil disturbance and litter deposition.

Sources of Errors

Errors can occur in the vegetation data. One way this occurs is when the wrong species code is entered at a point due to either misidentification or misspelling. This may happen on the data sheet or during entry into the database. Several error searches are performed during data management in order to minimize the number of incorrect codes in the database. Vouchers of plants whose identification is uncertain are collected for examination by other botanists. During data entry, many code errors are caught by Microsoft® Access, as it will accept only codes already entered in the Species List database. However, typing in a code for a plant species that occurs in the database but which is wrong for a particular point would not be detected. Proofing entered data helps to minimize this type of error. Error checking queries are run on the database after all data have been entered in order to detect missing or inappropriate codes or values.

Species identification has been questionable in some cases. Grasses may have not yet matured sufficiently for good species identification or some herbaceous annuals may have already become desiccated. In both cases, identification was made to the finest possible level. Assumptions about a plant’s identification were made only when previous years’ data strongly pointed to a particular species. Uncertain species identifications were left on the data sheets, but a broader, verifiable level of identification was entered in the database, though this might be only family or even life form. Codes entered into the database that differ from the data sheets are noted in red ink on the sheets next to the original entry.

Another type of error occurs when the transect and points are not in exactly the same place as previous years. The aluminum stakes that mark the transects are difficult to see in tall grass or shrubs and cannot always be found. In these cases, a substitute transect may be put out using transect photographs and distances and compass bearings from known landmarks as described in the *Terrestrial Vegetation Monitoring Handbook* (Halvorson et al 1988). These are as close as possible to the presumed original location, but they are not exact. Transects which have been relocated, temporarily or permanently, are described in the "Departures from Protocols" section of this report.

High winds are common during the sampling season. Even when tapes are pulled taut and close to the ground, some swaying occurs. This causes the sampled points to be offset to one side or the other from the actual transect which can result in a different species composition. Averaging the data from multiple transects in order to describe plant community composition provides some resilience to this type of error.

Sampling of too large an area can occur when researchers are not consistent about what proportion of the point pole they consider a hit. Some observers have recorded species that touched anywhere around the circumference. This would lead to more hits being recorded at a point than another researcher who counts only what touches the half of the pole facing the tape. Which side of the tape the pole is placed on becomes a bigger source of species variability if hits on all sides of the pole are recorded. For data collected so far, averaging the transect data within each community decreases the impact of these inconsistencies. To minimize these sorts of errors in the future, protocol standards have been set which require the observer to 1) only record those species which touch a line painted on the front of the pole; and 2) always place the pole on the uphill or north side of the meter tape.

Taxonomic Questions

Plant names used in the vegetation monitoring program are according to Hickman (1993) except where island taxa were not recognized as distinct from those on the mainland and were lumped with the mainland species. In these cases, taxonomy is according to Munz (1974) or Junak (1995).

Plants that could not be identified during transect sampling were collected and keyed at the field station or brought to the mainland for identification by other Park staff and local experts. These collections are often maintained at the Park for future reference or sent to the Santa Barbara Botanic Garden for long-term curation. Specimens that have not been identified to species appear in the species lists without a specific epithet after the generic name or as "unknown herb", "unknown grass", and so forth.

Plant identification has been particularly difficult or inconsistent for some species. For example, on Santa Rosa Island, there has been uncertainty about identification of *Arctostaphylos confertiflora* and *A. tomentosa*. Both names have been used on the transects, though both may not be present. Identification of the several *Agrostis* and *Polypogon* species on Santa Rosa Island is also inconsistent. One is alerted to possible misidentifications when the transect data show a sudden switch from one species to another or vacillation between two species that never occur together in the same year. This is particularly true of perennial plants that should not completely disappear in a single year. Where inconsistencies have been found changes were made in the database in order to get a more accurate data set. Changes were only made when the preponderance of evidence indicated there had been a misidentification. For example on San Miguel Island, transects 12, 14, and 16 listed *Poa douglasii* as a dominant native grass species from 1985 to 1995. In 1996 and 1997 the number of hits for *P. douglasii* dropped dramatically or was zero and there was a corresponding increase in the number of hits for *Leymus triticoides* which had never been recorded on those transects before. In 1998 though, *L. triticoides* "disappeared" from the transects and either *P. douglasii* or an unknown grass was recorded. Since both *P. douglasii* and *L. triticoides* are native perennial grasses, it is not likely that either species actually underwent such extreme fluctuations in their numbers. Rather it is more likely that *P. douglasii* was misidentified as *L. triticoides* in 1996 and

1997. It should also be noted that without the inflorescences, it can be very difficult to distinguish between *P. douglasii* and *L. triticoides*. For this situation, the hits recorded for *L. triticoides* were changed to *P. douglasii*.

However, in instances where it appears there has been confusion between two different species but for which there is no evidence as to the correct identification, the two species have been lumped. *Vulpia bromoides/ V. myuros* and *Avena barbata/ A. fatua* on some of the islands are examples of this situation. Because these species appear to play the same roles in their communities, we feel that lumping them would not cause a significant loss of information while keeping them separated would artificially inflate the species richness of a transect or vegetation community. Where researchers did identify to species level, these names have been preserved on the original datasheets.

All known instances of species lumping and unclear identification are included in Appendix B.

Departures from Protocols

Whereas the number of transects read each year varies due to weather, missing markers, nesting seabirds, and so on, most transects are read in most years. Notable exceptions to this have occurred however. In 1989, transects were not read on Anacapa Island, Santa Barbara Island, and San Miguel Island. In 1991, they were not read on Anacapa Island, Santa Barbara Island, San Miguel Island, and Santa Rosa Island. In 1992, no data was collected for any of the islands.

Transect 9N on Santa Barbara Island and Transect 11 on San Miguel Island have been semi-abandoned due to high cactus density. They are still photographed on an annual basis and Transect 11 on SMI was actually read in 2000. SMI-11 has been replaced with SMI-18. Transects 4, 10N, and 10S on Santa Barbara Island and 02W and 03W on Anacapa Island have not been abandoned, but their sampling has become sporadic and unpredictable due to brown pelicans (*Pelecanus occidentalis*) nesting on or near them. This is expected to continue. Transect 04W on Anacapa Island has not been sampled regularly because of its steepness and researchers' concern over damage to the vegetation. There is a similar concern with some of the coastal sage scrub transects on Santa Rosa Island.

Some transects become "lost" when their stakes get pulled up or broken off or when they are obscured by dense vegetation. In these cases, the missing "A" and/or "B" points of the transect are resurveyed using directions from the *Terrestrial Vegetation Monitoring Handbook*. Every effort is made to place the new transect as close as possible to the original, and a note is made on the data sheet so that it is clear that the data may be from a slightly different line.

Santa Barbara Island

Transects 3, 5, 7, 9, 10, 13, 15, 17, 18, 22 (8S), 23 (9S), and 24 (10S) were read in the exact same location every year. Transects 1 and 8 were read in the same exact location except for 2000 when they were not read because of brown pelican nesting. Transect 19 was read in the same exact location every year except for 1993 when it was not monitored. Transect 04 was read in the same location every year except for 1985, 1990, 1996, and 1998 when it was not read because of brown pelican nesting. Transect 02 was resurveyed in 1993 and again in 1994; since 1994, data have been collected from the 1994 location. Transect 06 was resurveyed in 1993; and data collected since then have been from that new location. Transect 11 may have been resurveyed in 1994; data collected since then have been from that new location. Transect 12 was resurveyed in 1993; and data collected since then have been from that new location. Transect 14 may have been resurveyed in 1994; data recorded since then have been from that location. Transect 20 was newly installed in 1994 and was resurveyed in 1995. Transect 21 was added in 1995.

Anacapa Island

All five transects on the east islet of Anacapa were read every sample year from 1984 through 1997, except for transect 5E which was not read in 1984. In 1998, only two of the transects were read and from 1999-2000 none of the transects were read. On the middle islet, all five transects were read in every sampling year from 1984 through 2000, except in 1999 when none of the transects were read because of brown pelican nesting. On the west islet of Anacapa, brown pelican nesting on the island has prevented reading of some transects in some years. The pelicans move around, so there is variation in which transects get read each year. Transects 01W and 06W on West Anacapa have also been read every year, except 1999 and 2000. Transect 02W was read in 1984, 1985, and 1987 but not since then. Transect 03W was read in 1984, 1985, 1986 and 1993. Transect 04W has been read in 1984, 1985, 1987, 1988, 1990, 1993, and 1994. Transect 05W has been read in every sampling year except 1994, 1999, and 2000.

San Miguel Island

Transects 07 and 13 through 16 have been read every sampling year. Transects 01, 03, 04, 05, 06, 08, 09, 10, and 12 have been done all years except 1995. Transect 02 has been done every year except 1995 through 1997. Transect 11 was done from 1984 through 1990. It was not read from 1993 to 1999 because of dense cactus (*Opuntia littoralis*). There is no Transect 17. Transect 18 was installed in 1994 and has been read every year since then except for 1995 and 2000.

East end of Santa Cruz Island

Even with a short history, transect monitoring on east end of SCI has been uneven at best. Releve sampling in 1997 identified seven plant communities on the east end of SCI. In 1998, 10 transects – of a proposed 30 – were installed and read there. The following year, 10 additional transects were installed. Surveys for the 10 transects installed the previous year were also conducted. Four of those 10 transects could not be re-located. Unfortunately, due to time constraints, only one of the transects could be replaced. In 2000, another concerted effort was made to relocate the three missing transects from 1998, however they could not be found. Two of those transects were replaced. The missing transect, 09, has still not been relocated. All of the transects installed in 1999 (except for transect 13) were relocated and read in 2000. Currently there are 21 transects on the east end of SCI. An additional nine transects are slated to be installed and read in 2001.

Santa Rosa Island

The large number of transects on Santa Rosa Island makes a narrative of what was done and changed each year infeasible. Transects have been relocated frequently due to breakage by cattle or because people have pulled out the stakes. Instead of a narrative, the transect history is presented in Table 2.

Table 2 Santa Rosa Island transects and their repositioning each year from 1996–2000

TR	1996	1997	1998	1999	2000
01	R-2	R-2	R-1	R-2	R-2
02	R-2	R-2	R-2	R-2	R-2
03	R-2	R-1	R-2	R-2	R-2
04	R-2	R-2	R-2	R-2	R-2
05	R-2	R-1	R-2	R-2	R-2
06	R	R-2	R-2	R-2	R-2

07	NR	NR-M	R-0	NR-M	NR-M
08	R-0	R-2	R-2	R-2	R-2
09	R-2	R-1	R-1	R-1+1	R-2
10	R-2	R-1	R-1	R-1+1	R-2
11	R-2	R-2	R-2	R-2	R-2
12	R	R-2	R-2	R-2	R-2
13	R-2	R-2	R-2	R-2	R-2
14	R-2	NR-M	R-0	R-2N	R-2
15	R-2	R-1	R-2	R-2	R-2
16	R-2	R-2	R-2	R-2	R-2
17	NR-M	R-0	R-2	R-2	R-2
18	R-2	R-0	R-2	R-2	R-2
19	NR-M	R-0	R-2	R-1+1	R-2
20	R-2	R-2	R-2	R-2	R-2
21	NR	R-2	R-1	R-2	R-2
22	NR-M	NR-M	R-0	R-2N	R-2
23	NR-M	R-2	R-2	R-2	R-2
24	NR-M	NR-2	R-0	R-1+1	R-2
25	R-2	R-2	R-2	R-2	R-2
26	NR-M	R-2	R-2	R-2	R-2
27	R-2	R-2	R-2	R-2	R-2
28	R-2	R-2	R-2	R-2	R-2
29	NR-M	NR-M	R-0	R-1+1	R-2
30	R	R-2	R-2	R-2	R-2
31	NR-M	R-0	R-0	R-2	R-2
32	R-2	R-2	R-2	R-2	R-2
33	NR-M	R-1	R-1	R-2	R-2
34	R-2	R-2	R-2	R-2	R-2
35	R-2	R-2	R-2	R-2	R-2
36	R-2	R-2	R-2	R-2	R-2
37	R-2	R-2	R-2	R-2	R-2
38	NR	R-2	R-0	R-2	R-2
39	R	NR	R-0	R-1+1	R-2
40	R	R-2	R-2	R-2	R-2
41	R	R-2	R-2	R-2	R-2
42	R-2	R	R-2	R-2	R-2
43	R-2	R	R-0	R-2	R-2
44	R-2	R-1	R-1	R-1+1	R-2
45	NR-M	R-0	R-1	R-1+1	R-2
46	NR-M	R-2	R-1	R-2	R-2
47	NR-M	R-2	R-0	R-1+1	R-2
48	R-0	NR-M	R-1	R-2	R-2
49	R-2	R-2	R-2	R-2	R-2
50	NR	R-2	R-2	R-2	R-2
51	R-2	R-2	R-2	R-2	R-2
52	R	R-2	R-2	R-2	NR
53	R	R-2	NR	R-2	NR
54	R-2	R-2	R-0	R-1+1	NR
55	R-2	R-2	R-2	R-2	NR
56	NR	R-2	R-0	NR	R-2
57	R-2	R-2	R-2	R-2	R-2
58	R-2	R-2	R-1	R-2	R-2
59	R-2	R-2	R-2	R-1+1	NR

60	R-2	R-2	R-2	R-2	NR
61	R-2	R-2	R-2	R-2	R-2
62	NR-M	R-2	R-2	R-2	R-2
63	NR-M	R-2	R-2	R-2	R-2
64	R-2	R-1	R-2	R-2	R-2
65	R-2	R-1	R-2	R-2	R-2
66	R	R-2	R-1	R-2	R-2
67	R	R-1	R-2	R-2	R-2
68	R-2	R-2	R-2	R-2	R-2
69	R-2	R-1	R-2	R-2	R-2
70	R-2	R-2	R-2	R-2	R-2
71	R-2	R-2	R-2	R-2	R-2
72	R-2	R-2	R-2	R-2	R-2
73	R-2	R-2	R-2	R-2	R-2
74	NR-M	R-1	R-2	R-2	R-2
75	NR-M	R-2	R-2	R-2	R-2
76	R-2	R-2	R-2	R-2	R-2
77	R-1	R-1	R-0	R-2	R-2
78	R-2	R-2	R-2	R-2	R-2
79	R	R-2	R-2	R-2	R-2
80	R-2	R-1	R-1	R-1+1	R-2
81	R-2	R-1	R-1	R-1+1	R-2
82	R-2	R-0	R-2	R-2	R-2
83	NR-M	NR	R-0	R-2N	R-2
84	R-2	R-2	R-1	R-1+1	R-2
85	NR-M	R-2*	R-2*	R-2*	R-2*
86	R	R-2	R-2	R-2	NR-M

[a] The letter R means the transcect was read in that year. The number following the letter R indicates the number of stakes or end pints that were located (i.e. R-2 means both stakes or endpoints were found; R-1 means only one stake or endpoint was located; and R-0 indicates that neither endpoint was found but that the transect was read using temporary points). R-1+1 indicates that only one original endpoint was located and that one endpoint had to be reset using distance and compass directions in the Terrestrial Vegetation Monitoring Handbook and photos taken in previous years. R-2N indicates the transect was read and that new stakes were placed at the endpoints.

[b] The letters NR indicate the transect was not read in that particular year. The letters NR-M indicate the transect was not read because of missing stakes.

[c] There is only one end stake for this transect. The number 85 is etched into stone to indicate the location of Point A on this transect.

*TR=Transect Number

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Notes—Transect 86 was installed in 1994 just upstream of the cattle exclosure in Lobo Canon. It was added as a comparison site for Transect 82 which occurs in a similar site inside the exclosure. This transect may be superfluous now that the cattle have been removed from SRI.

In 1997, the bases of the original 1990 stakes for Transect 24 were found. This location and the 1994 location do not overlap. The 1990 transect has convex topography and is more dominated by forbs; the 1994 location is concave and dominated by grasses.

Species composition on Transect 16 on Carrington Point changed significantly between 1990 and 1994 when a surrogate transect had to be installed. *Distichilis spicata* occurred on 60 points in 1990 and on zero points in 1994. *Leymus triticoides* was not recorded in 1990 but was hit 33 times in 1994. Due to the perennial nature of both species, it seems unlikely that there was a complete loss of one species and such rapid development of another in that time period. It is likely that the surrogate transect was located in a different phase of the grassland community.

RESULTS AND DISCUSSION

Species abundance data for each transect are presented in Appendix H. The data show a great deal of variation in the abundance of many species as well as the total amount of vegetation from year to year. Species with annual life histories show greater short-term natural variation in abundance because they rely exclusively on seed production and subsequent germination for year to year recruitment. Perennials seem to be more resilient to annual variations in rainfall and temperature, so show fewer extreme short-term increases or decreases due to these factors. Sudden decreases in perennial abundance may be the result of defoliation from insect predation, disease, or consumption by wildlife or deer and elk.

Table 3 Average number of hits on transects per year on Santa Barbara Island (SBI), Anacapa Island (ANI), San Miguel Island (SMI), Santa Rosa Island (SRI), and on the east end of SCI (ESCI).

	1984	*1985*	*1986*	*1987*	*1988*	*1990*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
SBI	135	186	217	162	195	44	213	132	209	174	148	180	114	187
ANI	167	200	214	234	248	78	285	229	233	205	189	248	--	266
SMI	161	158	183	214	196	109	230	191	224	194	202	237	182	216
SRI	--	--	--	--	--	121	238	239	185	189	146	194	149	157
ESCI	--	--	--	--	--	--	--	--	--	--	--	111	117	117

Note–-Direct comparison of averages between islands is not possible because of the differing transect lengths on some islands.

As noted in the 1984-1995 report (Johnson 1998), the year 1990 still stands out as having the lowest average number of hits recorded since 1984 (Table 3). The low number of hits on vegetation in 1990 are correlated with low annual rainfall (Table 4). The four years prior to the 1990 growing season were well below average, with 1989-90 being the lowest rainfall recorded since monitoring began in 1984.

Direct weather data from each of the islands are not complete. Data presented for Oxnard are gathered at a NOAA weather station. Data collected at the main ranch on Santa Cruz Island presents the most complete weather data collected from the islands. Comparison between the two locations shows they correlate fairly well and that the annual totals are within 4 inches of each other with the exceptions of 1983-84, 1991-92 and 1994-95

Table 4 Precipitation at Oxnard Weather Station and SCI – Main Ranch from 1983 to 2000.

Oxnard Precipitation (in inches) July -June				SCI Main Ranch Precipitation (in inches) July - June			
1983-84	**11.13**	1992-93	**25.27**	1983 - 84	**16.26**	1992 - 93	**25.17**
1984-85	**12.09**	1993-94	**11.66**	1984 - 85	**16.01**	1993 - 94	**15.37**
1985-86	**25.3**	1994-95	**28.82**	1985 - 86	**31.71**	1994 - 95	**45.13**
1986-87	**8.37**	1995-96	**11.44**	1986 - 87	**13.99**	1995 - 96	**15.56**
1987-88	**11.77**	1996-97	**13.95**	1987 - 88	**15.63**	1996 - 97	**23.35**
1988-89	**9.48**	1997-98	**36.77**	1988 - 89	**8.92**	1997 - 98	**43.28**
1989-90	**4.63**	1998-99	**9.42**	1989 - 90	**6.35**	1998 - 99	**9.56**
1990-91	**12.32**	1999-00	**13.82**	1990 - 91	**15.58**	1999 - 00	**13.87**
1991-92	**35.3**			1991 - 92	**20.45**		

Protocol Review

Recently the Terrestrial Vegetation Monitoring Program at Channel Islands National Park underwent a review of its methods and goals (McEachern 2001). A 16 person panel composed of researchers, agency personnel, and statisticians convened for 1½ days and proposed several recommendations for changes in the monitoring program. Of primary concern to the panel was the lack of adequate funding and personnel to maintain the program in its current form. At the same time the workload is expected to increase with the recent addition of the Isthmus on Santa Cruz Island. Options that were considered by the panel to address this problem included decreasing sampling frequency (by either only sampling some of the transects on all the islands or only sampling 2-3 islands per year), decreasing the number of points read per transect, and the grouping of transects to reduce travel time. Other recommendations for changes in the monitoring program included:

1. Expand the shrub and tree monitoring protocol developed for for Channel Islands National Park (McEachern 2000) to all the islands, not just SRI and the east end of SCI. Some modifications to the protocol were recommended to decrease potential damage to the vegetation and decrease the time needed to do the monitoring.
2. Evaluate the data using classification analysis to standardize community names across islands and between islands and the mainland.
3. Emphasize the importance of vegetation mapping on a periodic time table. This is already part of the original protocol but lack of funding has prevented its implementation. Vegetation maps exist for each of the islands but they have been completed by different researchers on a project by project basis. It was felt however, that the original timetable of every five years may be too frequent.

A complete overview of the Program Review should be published and available by the fall of 2001.

1995 Recommendations

The following recommendations were included in the Terrestrial Vegetation Monitoring Channel Islands National Park 1984 – 1995 Report (Johnson 1998). They are provided here as an additional means of assessing the current state of the vegetation monitoring program.

1. Convert Santa Barbara Botanic Garden (Philbrick 1978–1982) line-intercept data to point-intercept data and enter into Microsoft® Access to expand the period of sampling.
2. Modify woody community monitoring protocols. Point-intercept is not suitable for monitoring changes in density and stand structure.
3. Establish riparian monitoring protocols.
4. Establish microbiotic soil crust and litter/duff monitoring protocols.
5. Add a Transect 17 on San Miguel Island to increase data collected from the stabilized dune community.
6. Use a Global Positioning System (GPS) to document transect locations.
7. Verify and correct all possible taxonomic inconsistencies.

Since 1998, the following changes have been made to the vegetation monitoring program.

- Shrub and tree monitoring protocols developed by K. McEachern were initiated on the east end of SCI and SRI. They will be expanded to the other islands.

- Hits on soil crusts are recorded and tabulated in database. Hits on lichens and bryophytes are recorded as well. Currently identification is only to lifeform but it is anticipated that species level identification will occur in the future.
- Approximately ½ of the transect positions have been recorded by GPS. It is anticipated that the rest will be GPSed within two years.
- Taxonomic inconsistencies have been identified and corrections (where possible) have been made. Additional work needs to be done.

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APPENDIXES

APPENDIX A

Monitoring Dates and Personnel information

Monitoring Dates and Primary Personnel

Santa Barbara Island

Monitoring Dates		Primary Personnel
From	To	
3/26/96	4/2/96	Lauren Johnson
3/4/97	3/11/97	Lauren Johnson
3/10/98	3/13/98	Steve Junak
3/17/98	3/20/98	Steve Junak
3/17/98	3/24/98	Lauren Johnson
6/1/99	6/6/99	Steve Junak
4/4/00	4/7/00	Dirk Rodriguez
4/4/00	4/7/00	Steve Junak

Anacapa Island

Monitoring Dates		Primary Personnel
From	To	
4/1/96	4/5/96	Steve Junak
3/19/96	3/21/96	Steve Junak
3/18/97	3/21/97	Steve Junak
3/18/97	3/19/97	Lauren Johnson
4/2/98	4/3/98	Steve Junak
4/7/98	4/10/98	Steve Junak
5/4/98	5/5/98	Steve Junak
7/9/98	7/9/98	Lauren Johnson
5/3/00	5/4/00	Steve Junak

San Miguel Island

Monitoring Dates		Primary Personnel
From	To	
4/3/96	4/5/96	Heidi David
4/16/96	4/19/96	Lauren Johnson
3/31/97	4/3/97	Steve Junak
4/15/97	4/18/97	Steve Junak
4/14/98	4/17/98	Steve Junak
4/21/98	4/24/98	Steve Junak
4/14/99	4/15/99	Steve Junak
5/11/99	5/14/99	Steve Junak
4/25/00	4/27/00	Steve Junak
6/6/00	6/8/00	Steve Junak

Santa Rosa Island

Monitoring Dates		Primary Personnel
From	To	
4/12/96	4/16/96	Heidi David
4/30/96	5/7/96	Heidi David
5/14/96	5/24/96	Lauren Johnson
5/28/96	6/4/96	Lauren Johnson
4/1/97	4/8/97	Lauren Johnson
4/15/97	4/22/97	Lauren Johnson
5/13/97	5/20/97	Lauren Johnson
5/27/97	6/3/97	Lauren Johnson
6/20/97	6/24/97	Lauren Johnson
4/2/98	4/5/98	Lauren Johnson
4/7/98	4/14/98	Lauren Johnson
4/21/98	5/1/98	Jen Hooke
5/8/98	5/22/98	Jen Hooke
5/27/98	6/9/98	Jen Hooke
5/6/99	5/12/99	Dirk Rodriguez
5/19/99	5/26/99	Dirk Rodriguez
6/2/99	6/9/99	Skye Loyd
6/16/99	6/21/99	Skye Loyd
7/2/99	7/6/99	Skye Loyd
7/28/99	8/4/99	Dirk Rodriguez
5/10/00	5/16/00	Dirk Rodriguez
5/24/00	5/30/00	Dirk Rodriguez
6/8/00	6/13/00	Dirk Rodriguez
6/22/00	6/24/00	Dirk Rodriguez

East Santa Cruz Island

Monitoring Dates		Primary Personnel
From	To	
6/28/98	6/30/98	Lauren Johnson
8/12/98	8/16/98	Lauren Johnson
10/17/98	10/19/98	Lauren Johnson
7/1/99	7/2/99	Dirk Rodriguez
8/13/99	8/19/99	Dirk Rodriguez
8/31/99	9/3/99	Dirk Rodriguez
3/27/00	3/31/00	Dirk Rodriguez
5/2/00	5/6/00	Dirk Rodriguez

Personnel Affiliations and Period of Involvement

Personnel and Affiliation	Period of Involvement
Steve Veirs, Research Biologist, NPS	1983–1984
Jim Lenihan, Biotechnician, NPS	1983–1984
Bill Lennox, Biotechnician, NPS	1983–1984
Bill Halvorson, Research Biologist, NPS	1985–1990
Ronnie Clark, Biotechnician, NPS	1984–1988
Karen Danielsen, Biotechnician, NPS	1986–1990
Carla D’Antonio, Biotechnician, NPS	1987–1988
Steve Junak, Botanist, Santa Barbara Botanic Garden	1990, 1995-2000
Cece Sellgren, Range Conservationist, NPS	1993
Sarah Chaney, Botanist, NPS	1993–1994
Kathryn McEachern, Research Ecologist, USGS/BRD	1993–present
Heidi David, Biotechnician, NPS	1993–1995
Katie Chess, Biotechnician, NPS and USGS/BRD	1994–1995
Jen Gibson, Biotechnician, NPS	1995
Lauren Johnson, Botanist, NPS	1996-1998
Jennifer Hooke, Biotechnician, NPS	1998
Dirk Rodriguez, Botanist, NPS	1999-present
Skye Lloyd, Biotechnician, NPS	1999
Tim Dalyrmple, Biotechnician, NPS	2000

APPENDIX B

Species name and species identification uncertainties

Park-wide Changes

Because there has been confusion between *Avena fatua, Avena barbata; Vulpia myuros, Vulpia bromoides*, and the *Hordeum murinum* subspecies across all the islands, a general lumping was done for these species in the database. The Avenas are presented as *Avena barbata/fatua*. The Vulpias are presented as *Vulpia bromoides/myuros*, and *Hordeum murinum* ssp. *leporinum* and ssp. glaucum as just *Hordeum murinum*.

A more detailed description regarding the taxonomic confusion with these species can be found in Terrestrial Vegetation Monitoring Channel Islands National Park 1984-1995 Report (Johnson 1998). Previous discussion regarding other species from the previous report are retained here, as well as any taxonomic difficulties experienced between 1995 – 2000.

Santa Barbara Island

In 1995, confusion about the identity of *Bromus hordeaceus* and *Hordeum murinum* juveniles may slant data too heavily toward the brome. Young *B. arizonicus* may also have been identified as *B. hordeaceus*. On Transect 4, there is uncertainty about the identification of *B. arizonicus* and *B. carinatus* (1993, 1995).

Erodium moschatum was recorded on Transect 8 in 7 years. In 1993, *E. cicutarium* was reported. *E. moschatum* is recorded for 5 years on Transect 15, then is called *E. cicutarium* in 1993. It is likely this was a misidentification and this was changed in the database.

Opuntia littoralis was recorded on Transects 23 and 24 all years except 1993 when *O. oricola* was recorded on each. Because this is a likely misidentification, *O. oricola* was changed to *O. littoralis* in the database.

Anacapa Island

Eriogonum grande was identified as var. *grande* on Transects 03E and 02M in all years except 1995, when Steve Junak identified it as *E. grande* var. *rubescens*. Both species were lumped together as *E. grande* in the database.

Opuntia littoralis was recorded on Transect 02M in 1988; *O. oricola* was recorded here in 1993. *O. littoralis* was recorded during 5 years on Transect 04W; in 1993, *O. oricola* was recorded. *O. oricola* was changed to *O. littoralis* in the database.

A *Lepidium* was recorded as *L. nitidum* in 1987, as *L. sp*. in 1988, and as *L. oblongum* in 1993 and 1995. *L. nitidum* and *L. sp*. were changed to *L. oblongum* in the database.

There may be confusion between *Trifolium willdenovii* and *T. depauperatum* on Transects 05M.

Eriophyllum confertiflorum and *E. staechadifolium* have been alternately recorded in different years on Transects 01W, 02W, and 03W. *E. staechadifolium* was changed to *E. confertiflorum* for transect 01W and 02W in the database.

On Transects 03W, there were 25 hits on an unidentified shrub in 1984. This shrub may be *Epilobium canum* ssp. *angustifolium*. It is not listed in 1984, but it does occur in all the other years the transect was read. The unidentified shrub was changed to *E. canum* ssp. *angustifolium* in the database.

On Transect 06W, *Hordeum brachyantherum* had recorded hits on 5 monitoring years. In 1994, no hits were recorded for *H. brachyantherum* but *Bromus carinatus* was hit 21 times. 1994 was the only year that *B. carinatus* was recorded from this transect.

San Miguel Island

On Transect 05, there is uncertainty about the identification of *Opuntia littoralis* and *Opuntia oricola*. The first nine times this transect was monitored hits were recorded for *O. littoralis*. Then in 1997, nine hits were recorded for *O. oricola* and none for *O. littoralis*. The following year, eleven hits were recorded for *O. oricola* and one hit was recorded for *O. littoralis*. The next year, 1999, thirteen hits were recorded for *O. littoralis* and none for *O. oricola*. Then in 2000, twelve hits were recorded for *O. oricola* and none for *O. littoralis*. Both species are very similar in appearance and can be easily confused.

Plantago elongata is recorded on Transect 2 in 1987; *P. erecta* is recorded in 1993. *P. erecta* is not otherwise known to occur on San Miguel; it is likely that the 1993 record is a misidentification. This has not been corrected in the database because of the possibility that, either or both the recorded *P. elongata* and *P. erecta* are actually *P. ovata*.

On Transect 11, there seems to be confusion between *Nasella pulchra, Poa douglasii*, and *Leymus triticoides*. In 1984, twenty-eight hits were recorded on *N. pulchra* the only native grass touched during monitoring. The following year, seven hits were recorded on *P. douglasii*, but none for *N. pulchra*. In 1986, no hits were recorded for either species, however the following year, 13 hits were recorded for *P. douglasii*. In 1988, no hits were recorded for any native grass and no monitoring was done at that transect in 1989. This was followed by three hits being recorded for *Leymus triticoides* in 1990. No monitoring was done at this site until last year when 12 hits were recorded on *Nasella* sp.

Confusion between *P. douglasii* and *L. triticoides* also occurs on Transect 12. From 1984 to 1994, only hits for P. douglasii were recorded. No monitoring was done in 1995 but the following year no hits were recorded for *P. douglasii* but 17 hits were recorded for *Leymus triticoides*. This continued the following year when 21 hits were recorded for *L. triticoides* and only one hit on *P. douglasii*. In 1998 however, this reversed and 21 hits were recorded for *P. douglasii* with no recorded hits on *L. triticoides*. In 1999, there was only 1 hit for *P. douglasii* but 28 hits on an unknown grass. This was nearly repeated in 2000, when 22 hits were recorded for an unknown grass but no hits for *P. douglasii*. It is likely that all the hits for *L. triticoides* and the unknown grass are actually hits on *P. douglasii*. A similar pattern exists for Transects 14 and 16. However, for Transect 16, there is confusion between *P. douglasii, Bromus carinatus, L. triticoides* and *L. pacificus*.

Transect 18 has been monitored in 5 years. It was a replacement for Transect 11 which could not be monitored due to dense cactus growth. In the first two years of monitoring, no native perennial grasses were recorded as being hit. In the third year, five hits were recorded on *Nasella pulchra*. The following year, no hits were recorded for *N. pulchra* but four hits were recorded for *Nasella cernua* and one hit for *Nasella sp*. The last year the transect was monitored (1999) there were 11 hits for *Nasella sp*. but none for *N. pulchra* or *N. cernua*. Based on the data there is no clear indication has to which *Nasella* species occurs on this transect.

Santa Rosa Island

There seem to be taxonomic identification problems between *Leymus triticoides* and *Hordeum brachyantherum* on Transect 05. The first three years over thirty hits on *L. triticoides* were recorded each year. In the fourth year, no hits were recorded on *L. triticoides* but eight hits were recorded for the first time on the native perennial grass, *H. brachyantherum*. The following year, 1996, 26 hits were recorded for *H. brachyantherum* and three hits were recorded for *N. pulchra*. In 1997, 35 hits were recorded for *L. triticoides* but no hits were recorded for *H. brachyantherum* or *N. pulchra*. In 1998, 70 hits were recorded for *L. triticoides* and 44 hits were recorded for *H. brachyantherum*. The following two years though only *L. triticoides* was hit. Given that both *H. brachyantherum* and *L. triticoides* are perennial grasses, it is not likely that they could "disappear" completely in a given year.

Distinguishing between the Hordeum spp. on SRI has also been problematic. On seven transects (5, 12, 19, 23, 29, 36, and 37), hits have been recorded for both *H. brachyantherum* and *H. marinum* ssp. *gussoneanum* but, for the most part, not within the same year. The one exception is on transect 12, which from 1993 to 1999 had recorded hits only for *H. brachyantherum* but in 2000 had recorded hits for both *H. brachyantherum* and *H. marinum* ssp. *gussoneanum*. For two other transects, 28 and 32, there have been recorded hits for *H. brachyantherum*, *H. marinum* ssp. *gussoneanum*, and *Hordeum* sp. but again not within the same year. The hits on the unknown *Hordeum* likely represent either *H. brachyantherum* or *H. marinum* ssp. *gussoneanum* and indicate confusion between the identity of either species.

Identification of *Lolium multiflorum* and *Lolium temulentum* is a problem on Transects 10 and 66. Each species has appeared on both transects but there has been little or no overlap between the species on any given year. The data are inconclusive as to whether only one or both species are present.

There may be confusion about the identity of *Erodium botrys*, *E. moschatum, and E. cicutarium* on Transects 8, 9, 10, and 15.

Transect 11 has been monitored 8 times since 1990. Significant fluctuations in the presence and absence of *Nasella pulchra*, *N. lepida*, *Achnatherum diegoense*, *Carex globosa, Bromus carinatus, L. triticoides* and *Luzula comosa* have occurred from year to year. These species once recorded as being present have disappeared in subsequent years only to reappear again later. Since these are all native perennial plants, such considerable variation is not likely.

On Transect 13, there was confusion about a low-growing, wind-pruned oak that occurs at this transect. In habit, the oak resembles the island scrub oak (*Quercus pacifica*) but in reality, it is a coast live oak (*Quercus agrifolia*). This misidentification occurred in both 1997 and 1999. This was corrected in the database.

Confusion exists between *N. pulchra* and *A. diegoense* on Transect 34. This transect has been monitored nine times. Five of those years *N. pulchra* has been hit on this transect. In two years, *N. pulchra* wasn't hit but *Achnantherum diegoense* had recorded hits. It is not clear whether only one or both species are present.

Identification between *Bromus arizonicus* and *B. carinatus* on Transect 38 has been a problem. In 1993, seven hits were recorded on *B. arizonicus*. The following year, *B. arizonicus* was not hit but there were 14 hits on *B. carinatus*. *B. carinatus* is a perennial native grass while *B. arizonicus* is a similar-looking annual.

There is confusion among native grass species on Transects 55, 56, 57, 59, and 60. On Transect 55 and 57, there is confusion between *N. pulchra* and *N. lepida*. Transect 56 has a similar problem but with the addition of *B. carinatus*. On Transect 59, there are identification problems with *N. pulchra, N. lepida*, and *N. cernua*. For Transect 60, the confusion is between *N. pulchra* and *A. diegoense*.

There are a number of possible identification problems with long-lived perennial species on Transect 65. *Heteromeles arbutifolia*, which had 20+ hits on five different monitoring visits, had no recorded hits on three other visits. *Prunus ilicifolia*, which averaged approximately 16 hits the first six times the site was monitored, dropped to one and 5 hits in 1999 and 2000. *Quercus pacifica*, which had not had any recorded hits during the first six monitoring visits, was hit 5 and 6 times in 1999 and 2000 respectively. *Rhus integrifolia* which averaged over 47 hits the first five monitoring visits, was hit only 3 times in

1998 and only 20+ times in 1999 and 2000. This last fluctuation is probably due to a change in how the 50-m field tape has been positioned. The *Rhus integrifolia* on this transect is a very large shrub. Some observers have placed the tape over the shrub while others have placed it underneath the shrub. Placing the tape over the shrub uses more of the tape and allows for more hits on *R. integrifolia* to be recorded. A possible misidentification has also occurred with the grass species *Agrostis pallens* and *Distichilis spicata*. *A. pallens* has had recorded hits on this transect six of the eight times it has been monitored. *D. spicata* has had recorded hits on only 1 monitoring visit, 1996. Coincidentally, 1996 was one of the years that *A. pallens* did not have any recorded hits. It is possible that the hits recorded for *D. spicata* are actually hits on *A. pallens*.

There is inconsistency in identification of *Trifoliums* on several transects. *Trifolium microcephalum* and *T. willdenovii* have both been recorded on Transect 30, *T. depauperatum* and *T. willdenovii* on Transect 42, and *T. depauperatum* and *T. gracilentum* on Transect 44. These are all annual species, so it is possible that there is variation in what appears from year to year.

On Transect 65, it is likely that *Gnaphalium* sp. is *G. bicolor* and *Carex* sp. is *C. globosa* as these are the species identified there in other years.

Transect 68 has been monitored nine times since 1990. The site is mixed woodland with a dense overstory. *Quercus agrifolia* is present on this site and has been hit every year the transect has been monitored. *Quercus pacifica* is also at this site but it has recorded hits for only three of the monitoring years. The years when *Q. pacifica* was recorded as being present, it averaged over 60 hits and *Q. agrifolia* averaged over 30 hits. When *Q. pacifica* was not recorded as being on the transect, the hits for *Q. agrifolia* averaged over 89 hits per year. It is likely that a misidentification has occurred at this transect. If *Q. pacifica* is present on this site then approximately 2/3 of the hits attributed to *Q. agrifolia* in 1990, 1993, 1994, 1995, 1997, and 1999 are actually hits for *Q. pacifica*. However, since there is some doubt about the presence of *Q. pacifica*, no changes were made in the database.

There are significant changes in perennial species composition on Transect 80. In eight of the years the transect has been monitored, *D. spicata* has had recorded hits. However, in 1993 and 1994, the number of hits for *D. spicata* was significantly higher that any of the other years. Also, in 1993 and 1994, *Leymus triticoides* was hit 27 and 21 times, respectively but did not have any recorded hits in other year. This does not seem to be a case of misidentification but rather a change in the position of the transect line. In 1993 and 1994, one of the transect end stakes was missing and it is possible the transect was not read on its original line.

Because of confusion between *Arctostaphylos confertiflora* and *Arctostaphylos tomentosa*, these two species have been lumped in the database. It is likely though that most, if not all of the hits recorded, are for *Arctostaphylos confertiflora*.

APPENDIX C

All plant species intercepted on Santa Barbara Island transects, 1984 through 2000

A
Achillea millefolium
Amblyopappus pusillus
Amsinckia menziesii var. intermedia
Aphanisma blitoides
Artemisia californica
Astragalus traskiae
Atriplex californica
Atriplex pacifica
Atriplex semibaccata
Avena barbata
Avena fatua

B
Bromus arizonicus
Bromus carinatus ssp. carinatus
Bromus hordeaceus
Bromus madritensis
Bromus trinii

C
Cakile maritima
Calystegia macrostegia ssp. amplissima
Chenopodium californicum
Chenopodium murale
Claytonia perfoliata ssp. mexicana
Coreopsis gigantea
Crassula connata
Cryptantha clevelandii
Cryptantha maritima

D
Dichelostemma capitatum

E
Eriogonum giganteum var. compactum
Erodium cicutarium
Erodium moschatum
Eschscholzia californica

G
Galium aparine

H
Hemizonia clementina
Hordeum murinum ssp. glaucum

L
Lamarckia aurea
Lasthenia californica
Lepidium nitidum ssp. nitidum
Lycium californicum

M
Malacothrix foliosa ssp. philbrickii
Malephora crocea
Malva parviflora
Marah macrocarpus
Medicago polymorpha
Melica imperfecta
Melilotus indicus
Mesembryanthemum crystallinum
Mesembryanthemum nodiflorum
Mirabilis californica
Moss
Muhlenbergia microsperma

O
Opuntia littoralis
Opuntia oricola
Opuntia prolifera

P
Parapholis incurva
Parietaria hespera
Perityle emoryi
Phacelia distans
Phalaris minor
Pholistoma auritum
Pholistoma racemosum
Platystemon californicus var. californicus
Pterostegia drymarioides

S
Scleranthus annuus
Silene gallica
Sonchus asper
Sonchus oleraceus
Suaeda taxifolia

T
Trifolium willdenovii

V
Vulpia bromoides
Vulpia myuros
Vulpia octoflora

APPENDIX D

All plant species intercepted on Anacapa Island transects, 1984 through 2000.

A
Achillea millefolium
Agrostis viridis/stolonifera
Allium praecox
Amblyopappus pusillus
Amsinckia menziesii var. intermedia
Anagallis arvensis
Apiastrum angustifolium
Artemisia californica
Atriplex californica
Atriplex semibaccata
Avena barbata
Avena fatua

B
Baccharis pilularis
Bromus carinatus ssp. carinatus
Bromus carinatus ssp. maritimus
Bromus carinatus/arizonicus
Bromus diandrus
Bromus hordeaceus
Bromus madritensis ssp. rubens
Bromus maritimus
Bromus trinii

C
Calystegia macrostegia ssp. macrostegia
Castilleja affinis
Castilleja lanata ssp. hololeuca
Cerastium glomeratum
Chenopodium murale
Claytonia perfoliata ssp. perfoliata
Coreopsis gigantea
Crassula connata

D
Daucus pusillus
Delphinium parryi
Dichelostemma capitatum
Distichlis spicata
Dodecatheon clevelandii ssp. insulare
Dudleya caespitosa

E
Encelia californica
Epilobium canum ssp. angustifolium
Eriogonum arborescens
Eriogonum grande var. grande
Eriogonum grande var. rubescens
Eriophyllum confertiflorum
Eriophyllum staechadifolium
Erodium cicutarium
Erodium moschatum
Eucrypta chrysanthemifolia

F
Frankenia salina

G
Galium angustifolium var. foliosum
Galium aparine
Gilia clivorum
Gilia nevinii
Gnaphalium bicolor
Gnaphalium californicum
Gnaphalium canescens var. microcephalum
Grindelia camporum var. bracteosum
Guillenia lasiophylla

H
Hazardia detonsa
Hemizonia clementina
Hordeum brachyantherum
Hordeum intercedens
Hordeum murinum ssp. glaucum

I
Isocoma menziesii

L
Lamarckia aurea
Lasthenia californica
Lathyrus vestitus ssp. vestitus
Lepidium nitidum var. nitidum
Lepidium oblongum var. insulare
Lessingia filaginifolia var. filaginifolia
Leymus condensatus
Lotus dendroideus var. dendroideus
Lupinus albifrons
Lupinus bicolor

M
Malacothrix saxatilis var. implicata
Malephora crocea
Malva parviflora
Marah macrocarpus
Medicago polymorpha
Melica imperfecta
Melilotus indicus
Mesembryanthemum crystallinum
Mesembryanthemum nodiflorum

Microseris heterocarpa
Mimulus flemingii
Mirabilis californica
Moss
Muhlenbergia microsperma

N
Nasella pulchra

O
Opuntia littoralis
Opuntia oricola
Opuntia prolifera

P
Parapholis incurva
Parietaria hespera
Pellaea andromedifolia
Pentagramma triangularis ssp. triangularis
Phacelia distans
Phalaris minor
Poa secunda
Polypodium californicum
Pterostegia drymarioides

R
Ranunculus californicus var. californicus

S
Sanicula arguta
Selaginella bigelovii
Senecio vulgaris
Silene gallica
Silene laciniata ssp. major
Sonchus oleraceus
Spergularia macrotheca var. macrotheca
Stellaria media
Suaeda taxifolia

T
Trifolium depauperatum
Trifolium willdenovii

V
Vulpia bromoides
Vulpia myuros
Vulpia octoflora

Z
Zigadenus fremontii

APPENDIX E

All plant species intercepted on San Miguel Island transects, 1984 through 2000.

A
Abronia maritima
Abronia umbellata
Achillea millefolium
Allium praecox
Amblyopappus pusillus
Ambrosia chamissonis
Amsinckia menziesii var. intermedia
Artemisia californica
Astragalus curtipes
Astragalus miguelensis
Atriplex californica
Atriplex semibaccata
Avena barbata
Avena fatua

B
Baccharis pilularis
Bromus arizonicus
Bromus carinatus ssp. carinatus
Bromus carinatus ssp. maritimus
Bromus diandrus
Bromus hordeaceus
Bromus madritensis ssp. rubens
Bromus maritimus

C
Cakile maritima
Calandrinia ciliata var. menziesii
Calystegia macrostegia ssp. macrostegia
Camissonia cheiranthifolia var. cheiranthifolia
Camissonia micrantha
Carpobrotus chilensis
Castilleja exserta
Castilleja lanata ssp. hololeuca
Cerastium glomeratum
Chenopodium californicum
Cirsium occidentale
Claytonia perfoliata ssp. perfoliata
Conyza canadensis
Coreopsis gigantea
Crassula connata
Cryptantha clevelandii

D
Daucus pusillus
Dichelostemma capitatum
Distichlis spicata var. stolonifera
Dudleya caespitosa
Dudleya greenei

E
Erigeron glaucus
Eriogonum grande var. rubescens
Eriophyllum confertiflorum
Eriophyllum staechadifolium
Erodium cicutarium
Erodium moschatum
Erysimum insulare
Eschscholzia californica

F
Frankenia salina

G
Galium aparine
Gnaphalium luteo-album

H
Hordeum brachyantherum
Hordeum murinum ssp. glaucum
Hordeum murinum ssp. leporinum

I
Isocoma menziesii

J
Juncus mexicanus

L
Lamarckia aurea
Lasthenia californica
Layia platyglossa
Lessingia filaginifolia var. filaginifolia
Leymus triticoides
Lotus dendroideus var. dendroideus
Lotus scoparius
Lupinus albifrons
Lupinus arboreus
Lupinus succulentus

M
Malacothrix incana
Malacothrix saxatilis var. implicata
Malva parviflora
Marah macrocarpus
Marrubium vulgare
Medicago polymorpha
Melilotus indicus
Mesembryanthemum crystallinum
Mesembryanthemum nodiflorum

N
Nasella pulchra
Nemophila pedunculata

O
Opuntia littoralis

P
Parapholis incurva
Phacelia distans
Phalaris minor
Plantago elongata
Plantago erecta
Platystemon californicus var. californicus
Poa douglasii
Polypogon monspeliensis
Pterostegia drymarioides

S
Senecio vulgaris
Silene gallica
Sisyrinchium bellum
Solanum douglasii
Sonchus oleraceus
Spergularia macrotheca var. macrotheca
Stellaria media

T
Torilis nodosa

V
Vulpia bromoides
Vulpia myuros

APPENDIX F

All plant species intercepted on Santa Rosa Island transects, 1984 through 2000.

A
Abronia maritima
Abronia umbellata
Achillea millefolium
Achnatherum diegoense
Achyrachaena mollis
Adenostoma fasciculatum var. fasciculatum
Adiantum jordanii
Agrostis pallens
Agrostis viridis
Amblyopappus pusillus
Ambrosia chamissonis
Amsinckia menziesii var. intermedia
Anagallis arvensis
Arctostaphylos confertiflora
Artemisia californica
Astragalus miguelensis
Astragalus traskiae
Astragalus trichopodus var. lonchus
Atriplex californica
Atriplex semibaccata
Avena barbata
Avena fatua

B
Baccharis pilularis
Bloomeria crocea
Bowlesia incana
Brodiaea jolonensis
Bromus arizonicus
Bromus carinatus
Bromus diandrus
Bromus hordeaceus
Bromus madritensis ssp. rubens

C
Cakile maritima
Calandrinia breweri
Calandrinia ciliata var. menziesii
Calochortus albus
Calystegia macrostegia ssp. macrostegia
Camissonia cheiranthifolia ssp. cheiranthifolia
Camissonia micrantha
Capsella bursa-pastoris
Cardamine californica
Cardionema ramosissimum
Carex globosa
Carex pansa
Carpobrotus chilensis
Castilleja exserta
Centaurea melitensis
Cerastium glomeratum
Chenopodium californicum
Chenopodium murale
Cirsium occidentale
Cirsium vulgare
Clarkia davyi
Clarkia epilobioides
Claytonia perfoliata ssp. perfoliata
Cotula australis
Cotula coronopifolia
Crassula connata
Cressa truxillensis
Cryptantha clevelandii
Cryptantha micromeres
Cynodon dactylon

D
Daucus pusillus
Dichelostemma capitatum
Dichondra occidentalis
Distichlis spicata var. stolonifera

E
Eleocharis acicularis
Eleocharis macrostachya
Elymus sp.
Epilobium canum ssp. angustifolium
Erigeron glaucus
Erigeron sanctarum
Eriogonum grande var. rubescens
Eriophyllum confertiflorum
Erodium botrys
Erodium cicutarium
Erodium moschatum
Eschscholzia californica

F
Filago californica
Frankenia salina

G
Galium angustifolium ssp. foliosum
Galium aparine
Galium nuttallii ssp. insulare
Gastridium ventricosum
Geranium dissectum
Gilia achilleifolia ssp. multicaulis
Gilia clivorum
Gnaphalium bicolor
Gnaphalium californicum
Gnaphalium luteo album

Gnaphalium purpureum
Gnaphalium stramineum
Grindelia camporum var. bracteosum
Guillenia lasiophylla

H

Helianthemum scoparium
Hemizonia fasciculata
Heteromeles arbutifolia
Hieracium argutum
Hordeum brachyantherum
Hordeum intercedens
Hordeum marinum ssp. gussoneanum
Hordeum murinum
Hypochaeris glabra

I

Isocoma menziesii
Isomeris arborea

J

Jaumea carnosa
Juncus bufonius
Juncus mexicanus
Juncus phaeocephalus var. phaeocephalus

K

Keckiella cordifolia
Koeleria macrantha

L

Lactuca saligna
Lamarckia aurea
Lasthenia californica
Layia platyglossa
Lepidium lasiocarpum var. lasiocarpum
Lepidium nitidum var. nitidum
Lepidium virginicum var. pubescens
Lessingia filaginifolia var. filaginifolia
Leymus condensatus
Leymus pacificus
Leymus triticoides
Lolium multiflorum
Lolium temulentum
Lomatium caruifolium
Lotus dendroideus var. dendroideus
Lotus strigosus
Lotus wrangelianus
Lupinus albifrons
Lupinus arboreus
Lupinus bicolor
Lupinus concinnus var. agardhianus
Lupinus succulentus
Luzula comosa
Lyonothamnus floribundus ssp. aspleniifolius

M

Malacothrix incana
Malephora crocea
Malva parviflora
Marah macrocarpus
Medicago polymorpha
Melica imperfecta
Melilotus indicus
Mesembryanthemum crystallinum
Mesembryanthemum nodiflorum
Micropus californicus
Microseris douglasii ssp. tenella
Microseris heterocarpa
Microseris linearifolia
Mimulus flemingii
Mimulus guttatus
Moss
Muhlenbergia microsperma

N

Nasella lepida
Nasella pulchra
Navarretia atractyloides

O

Opuntia littoralis

P

Parapholis incurva
Parietaria hespera
Pellaea andromedifolia
Pentagramma triangularis ssp. triangularis
Phacelia distans
Phacelia ramosissima var. austrolitoralis
Pinus muricata forma remorata
Pinus torreyana ssp. insularis
Plagiobothrys collinus
Plantago erecta
Plantago ovata
Platystemon californicus var. californicus
Poa douglasii
Poa secunda
Polygonum arenastrum
Polypodium californicum
Polypogon interruptus
Prunus ilicifolia ssp. lyonii
Pterostegia drymarioides

Q

Quercus agrifolia var. agrifolia
Quercus macdonaldii
Quercus pacifica
Quercus tomentella

R

Ranunculus californicus var. californicus
Rhus integrifolia
Rumex crispus
Ruppia maritima

S

Salicornia virginica
Salix lasiolepis
Salvia brandegei
Sambucus mexicana
Sanicula arguta
Scirpus pungens
Selaginella bigelovii
Senecio vulgaris
Sidalcea malviflora
Silene gallica
Silene laciniata ssp. major
Silybum marianum
Sisyrinchium bellum
Solanum douglasii
Solidago californica
Sonchus asper
Sonchus oleraceus
Spergularia macrotheca var. macrotheca
Stachys bullata
Stebbinsoseris heterocarpa
Stellaria media
Stylocline gnaphalioides

T

Torilis nodosa
Trifolium depauperatum
Trifolium gracilentum var. palmeri
Trifolium microcephalum
Trifolium willdenovii
Triodanis biflora
Typha domingensis

U

Uropappus lindleyi
Urtica urens

V

Vaccinium ovatum
Vicia americana
Vicia hassei
Viola pedunculata
Vulpia bromoides
Vulpia myuros
Vulpia octoflora

Z

Zigadenus fremontii

APPENDIX G

All plant species intercepted on East Santa Cruz Island transects, 1984 through 2000.

A
Algae
Amblyopappus pusillus
Amsinckia menziesii var. intermedia
Apiastrum angustifolium
Arctostaphylos viridissima
Artemisia californica
Astragalus miguelensis
Avena barbata
Avena fatua
Avena sp.

B
Bowlesia incana
Brachypodium distachyon
Brassica nigra
Bromus diandrus
Bromus hordeaceus
Bromus madritensis
Bromus sp.

C
Ceanothus arboreus
Centaria melitensis
Claytonia parviflora ssp. parviflora
Claytonia perfoliata ssp. mexicana
Comarostaphylos diversiloba
Crassula connata
Cressa truxillensis
Crustose lichen
Cryptantha sp.

D
Daucus pusillus
Dichlostemma capitatum

E
Eremocarpus setigerus
Erodium cicutarium
Erodium moschatum
Eucrypta chrysanthemifolia

F
Filago californica

G
Galium aparine
Gastridium ventricosum
Geranium carolinianum

H
Heteromeles arbutifolia
Hirschfeldia incana
Hordeum murinum
Hordeum sp.
Hypochaeris glabra

I
Lasthenia californica
Lamarckia aurea
Lichen
Lolium multiflorum
Lupinus bicolor
Lyonothamnus floribundus ssp. aspleniifolius

M
Marah macrocarpus var. major
Medicago polymorpha
Moss

N
Nasella pulchra

P
Phalaris minor
Poa annua
Prunus ilicifolia
Pterostegia drymariodes

Q
Quercus agrifolia
Quercus agrifolia x parvula
Quercus pacifica
Quercus macdonaldii

U
Unknown grass
Unknown herb
Urtica urens

S
Sanicula arguta
Selaginella bigelovii
Sidalcea malviflora
Silene gallica
Sonchus oleraceus
Spergularia macrotheca ssp. macrotheca
Stellaria media

T

Trifolium microcephalum

V

Viola pedunculata
Vulpia bromoides
Vulpia myuros
Vulpia sp.

APPENDIX H

The number of interceptions of each species on each transect for each year the transect was read

This appendix presents the number of hits on each species on each transect for each year the transect was read. The locations of the species on the transect and the height of the highest intercept at each point are not displayed. The transects are grouped by island and are presented in numerical order.

Each transect is presented in its own table. The table has a title bar, a Lifeform column, a Species column, and annual data columns.

The title bar shows the island on which the transect occurs, the plant community the transect represents, and the number of points on the transect.

The Lifeform column indicates the life forms into which the plant species are grouped. Species are classified as trees, shrubs, sub-shrubs, graminoids, or other herbaceous forms, as annuals or perennials, and as natives or exotics. Sedges and rushes are part of the graminoid group. Sub-shrubs are distinguished by aboveground tissues that are predominantly non-woody, whereas shrubs have well-developed woody branches. The distinction between trees and arborescent shrubs is subjective. The following species are identified as trees:

Lyonothamnus floribundus
Pinus remorata
Pinus torreyana
Prunus lyonii
Quercus agrifolia
Quercus dumosa
Quercus macdonaldii
Quercus pacifica
Quercus tomentella
Salix lasiolepis
Sambucus mexicana

Below the Layer, Species, and Data columns are sections that show the total number of vegetation hits each year (necessary to compute relative frequency for each species), the number of hits on different substrates, and the percentage of the transect points where no vegetation was hit. Years in which a transect was not read are apparent by the empty column below that year's heading. As discussed in the Techniques section, substrate data were recorded differently from year to year. The type of recording in any given year can be determined by comparing the number of substrate hits with the number of transect points. Substrate hits will equal the number of points on the transect in years when substrate was recorded at every point.

The relative frequency of each species on a given transect can be calculated by dividing the number of hits on that species by the total number of plant interceptions on the transect. For example, on Transect 01E on Anacapa Island in 1984, there were 39 hits on *Malephora crocea*. There were 131 total vegetation hits. The relative frequency of *M. crocea* is (39 / 131) = 0.298. In other words, 29.8% of the hits on the transect were *M. crocea*. The sum of the relative frequencies on a transect should equal 1.0.

Canopy cover for each species can be extrapolated by dividing the number of hits on the species by the number of points on the transect. Transect 01E on Anacapa Island has 100 points. The canopy cover of *M. crocea* is (39 / 100) = 39%. The sum of the canopy covers can exceed 100%.